

HOW PAPER



IS MADE

Scribe
Writing on
Papyrus

HOW PAPER IS MADE

*AN HISTORICAL SKETCH OF THE INDUSTRY, AND A
DETAILED DESCRIPTION OF THE PROCESS OF PAPER
MAKING AT THE MILLS OF THE WHITING PAPER
COMPANY, IN HOLYOKE, MASSACHUSETTS, U. S. A.*

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It would be difficult to imagine a modern community getting along without paper, for the uses of paper are almost past numbering. Paper is one of the essentials of civilization. We are dependent on it in many details of business operations, and for the acquisition of knowledge and the dis-

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semination of news. It also greatly facilitates social intercourse.

Paper is a fabric that is composed of vegetable fibers minutely divided and reduced with water to a fine smooth pulp, and dried to form thin sheets. Hornets were the first paper-makers, and most people are familiar with the ingenious gray nests that these insects make and suspend under the eaves of buildings or from the branches of trees and bushes. Sometimes the nests are more than a foot in diameter.

Probably the earliest use of paper was for writing, and its earliest form the papyrus of the Egyptians. The papyrus was a natural paper made from the layers of membrane that underlie the outer skin of the tall slender papyrus plant, near its base. The Egyptians had found a way to make this kind of paper as long ago as 2000 B.C.

In India and China the art was early discovered of writing with a sharp point on dried palm leaves and on certain kinds of bark. It is known that the Chinese were making paper from pulp, artificially prepared, at the beginning of the Christian era. The materials used by the Chinese in their paper-making were the bark of trees, the soft parts of bamboo stems, and cotton. The Arabians learned from the Chinese how to make paper of cotton, and they carried the knowledge to Spain. There the Moors not only made paper of cotton, but apparently also of hemp and flax. Presently paper was being made in France and Holland, and in 1490 its manufacture was begun in England. By that time it was customary to use linen rags for fine paper.

The manufacture of paper in America was not undertaken until 1690, when a mill was established at Germantown in what is now a part of Philadelphia. Several days were required for finishing a sheet of dry perfected paper in this mill, and a day's work for three men was four and

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Sorting the Rags

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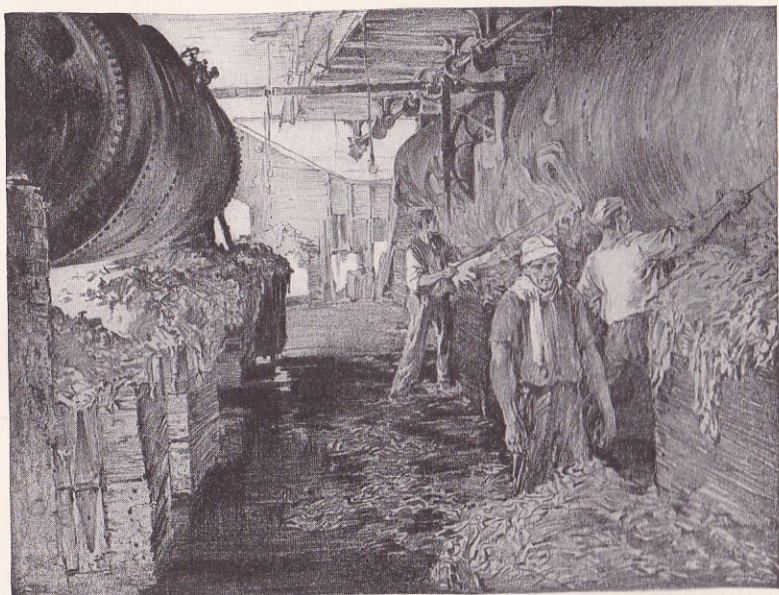
one-half reams of newspaper, 20 x 30. In 1728 the first New England mill came into existence at Milton, Massachusetts, near Boston. By 1810 the number of mills in the United States had increased to nearly two hundred.

In the early days, when all paper was made by hand, five or ten reams a day were considered a fair product for one mill. Hand-making required a week to do what a machine accomplishes in a day. But qualities and effects can be obtained by hand which are impracticable by machinery alone, although in most respects the machine-made paper is distinctly superior.

When making by hand the workman took a "mold," consisting of a piece of fine wire cloth attached to a frame, and placed on it another frame called a "deckle," which formed a thin rim around the mold. Then he dipped the mold into the pulp, and the deckle served to retain just enough for a sheet of paper of the required thickness. A little shaking made the water drain speedily through the wire cloth, and, after the deckle had been removed, the mold was turned over so that the moist sheet of paper was transferred to a piece of felt. Successive sheets were similarly treated, and they were piled one on another alternating with pieces of felt until there was a pile of about half a dozen quires. This pile was put in a press, which forced out nearly all the moisture in the sheets of paper. The cloths were then removed, and, after more pressings and other minor operations, the paper was hung over poles in a drying loft. When dried, it resembled blotting-paper and could not be written on. A writing surface was obtained by dipping it in a weak solution of hot gelatine, after which it was pressed and dried. If glazing was required the sheets were passed between hot and polished iron rollers.

Modern paper-making may be said to date from the introduction of the Fourdrinier type of paper-machine about 1806. This machine causes an equal supply of pulp

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The Boilers

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to flow on a horizontal wire-surface of fine mesh, which revolves and carries the paper along on to an endless felt. The machines have been brought to such perfection that paper can be made in one continuous web of any length; and before leaving the machine the paper is sized, dried, calendered, and, if desired, cut into sheets.

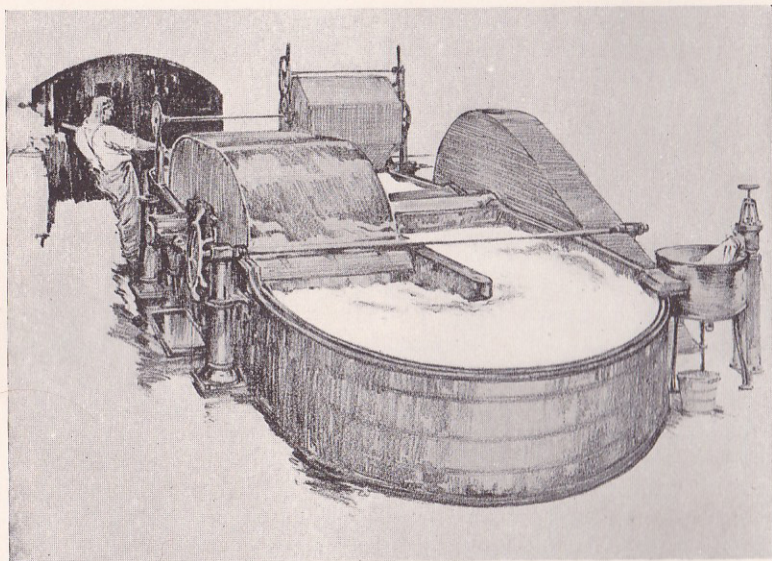
Pulp manufactured from straw made its appearance in this country in 1857, and the first wood-pulp paper-mill began operations in 1870. The pulp logs are for the most part floated from the forest down a river to the mill in four foot lengths, and the mill's first task is to get rid of the bark. Revolving cams of a barking machine rub the logs against each other, and remove the bark, which, with all the dirt, is washed away by constant streams of water. Next the logs are sawed into shorter lengths and fed to the chipping machines. From these the chips go to huge upright steel cylinders known as "digesters" to be cooked in a preparation of bisulphate of lime. This process eliminates the woody elements not useful in the pulp and leaves only the long, tough, flexible fibers of cellulose. Afterward the pulp is washed, screened, and bleached. Then the moisture is squeezed out by huge hydraulic presses, and the pulp is folded into laps and shipped. Methods differ to some degree, but the above description fairly represents the process for making a high-grade product.

Rags, however, are the chief ingredient of all fine writing papers. They are fragments from mills and shops, and discarded wearing materials from every part of the world, and they are of every color and every quality.

Gathering them from among the homes, either in the big towns or in the country villages and farmlands, involves much that is



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A Beater

H O W P A P E R I S M A D E

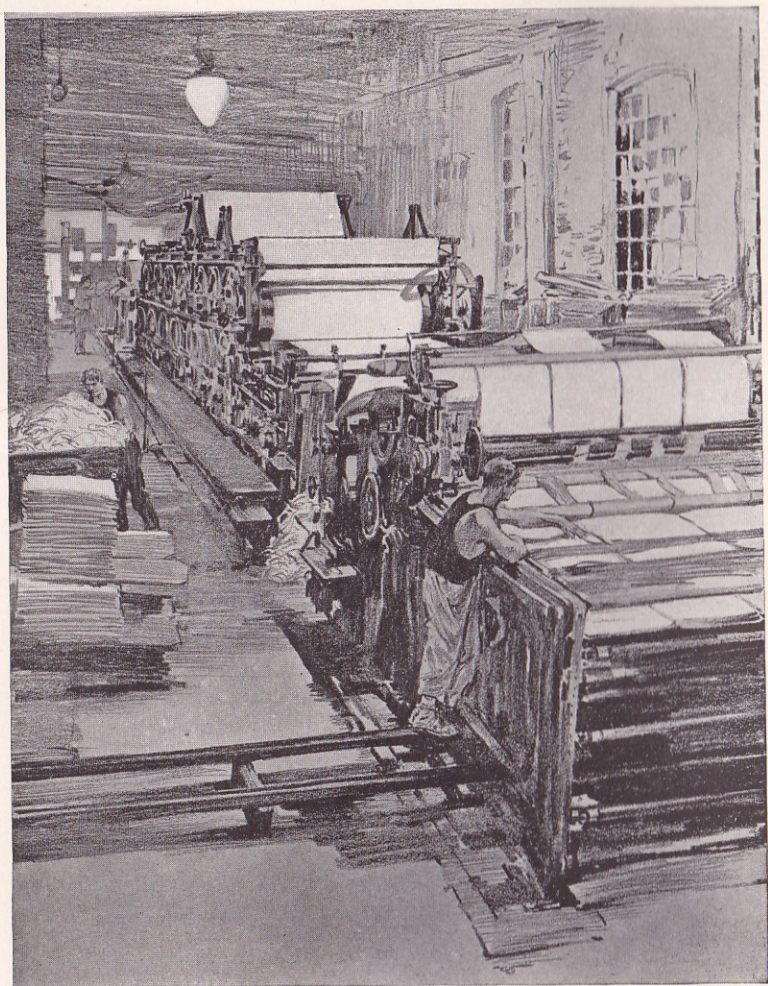
picturesque, and they represent not a little care and thrift. Eventually they find their way to dealers, who sort, grade, and bale the rags and send them to the mills. Many of the rags used come from the Old World countries across the seas. No doubt enough rags are produced in this country to supply the demand, but most people will not take the trouble to save them.

White rags make better paper than colored rags, for the powerful chemicals used to remove the color injure to some degree the fiber of the material. Rags that are weak in fiber, through much wear, or exposure to the weather, or lack of care, are chiefly used for making blotting paper. New white cuttings are superior to all others. A great many of them are the clippings from manufacturers of shirts and underwear. Makers of clothing furnish much other material, as also do makers of bedticks; and the clippings from the irregular pieces of cloth used for shoe linings are an important source of supply. The finest and strongest writing papers, such as bonds and ledgers, are made from rags.

Let us visit one of the great modern mills where high-grade papers for correspondence are made. To see the process from beginning to end we first go to a portion of the mill where several immense rooms on the lower floors are given up to the storage of the raw material. The great bales of rags, weighing about eight hundred pounds each, rise tier on tier clear to the ceiling.

Next we ride on the elevator to the fourth story. Here the bales of rags are being slashed open by a man with a big knife, the sacking is removed, and the closely packed mass within is pulled to pieces and thrown into a great hopper, where a swiftly-revolving wheel, thick-set with jagged teeth, catches the rags on its spikes, and whirls them about so fiercely that you wonder to find any rags left after the process. Yet this is simply the first step

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A Paper Machine

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toward a thorough cleansing, and its aim is to get out the dust and loosen the rags.

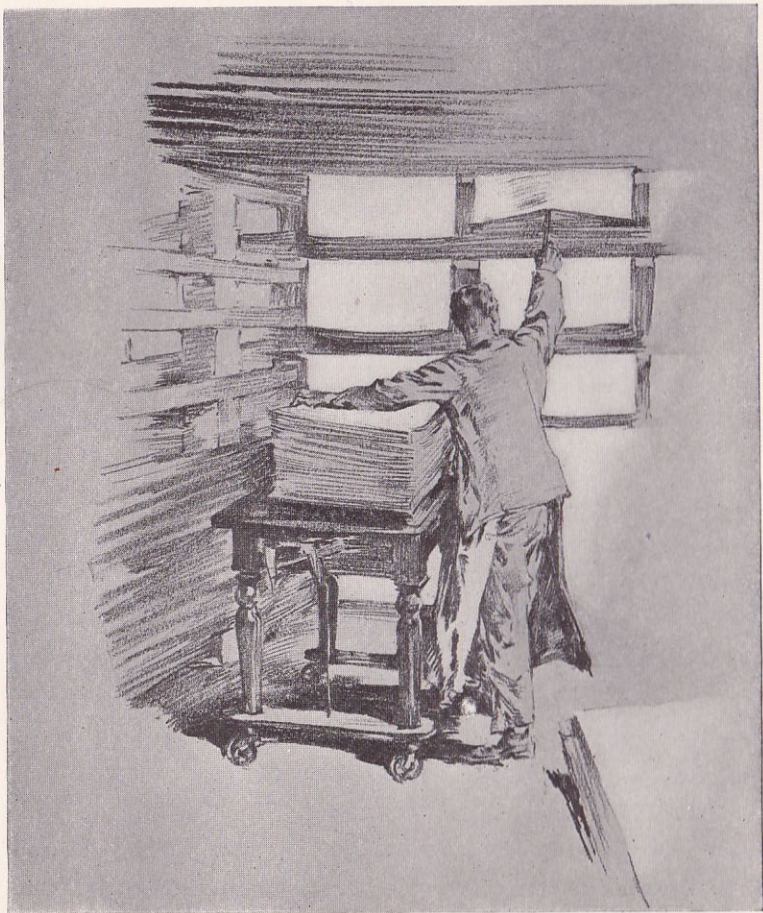
From the hopper the rags fall into a large room, where many girls are busy sorting and grading the rags to obtain a uniformity of material for manufacture. The girls in this room wear a kind of uniform, for each has, at least, a blue cap and an apron. Most of them stand facing the windows before a wide continuous bench consisting of shallow bins that have bottoms of coarse wire screening. Buttons, rubber, and metal abound in the rags, and each girl has in front of her a heavy, upright knife like a broad-bladed scythe, which does service in cutting these off. Behind her are two or three enormous baskets into which the different sortings of rags are thrown.

The rags go from the "screen girls" to the "table girls," for a more thorough sorting, and the heavily-loaded baskets that the latter fill are slid into a little side room, where their contents are fed into a low, rattling, grinding, jarring machine known as "the cutter." Six feet from the starting point, this machine delivers the rags all chopped into pieces from one to three inches square at the rate of two tons an hour. Until comparatively recent years the work of this mechanical cutting-monster was done by hand on the scythe-like knives in the room adjoining.

The cutter drops the rags on a revolving strip of canvas, which carries them downstairs, and lets them fall into a dusting machine—a huge box or small room equipped with fans, wire netting, and other apparatus. Lift a door and look in, and you see the rags rolling about within the box; and below is a thick deposit of linty "dust." This "dust" is nearly white and appears entirely suited for fine paper, but it is all sold to mills which manufacture a much coarser grade of paper than is used for writing purposes.

The rags pass through several of these dusters, one after another, and then are caught on a belt of canvas

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Loft Drying

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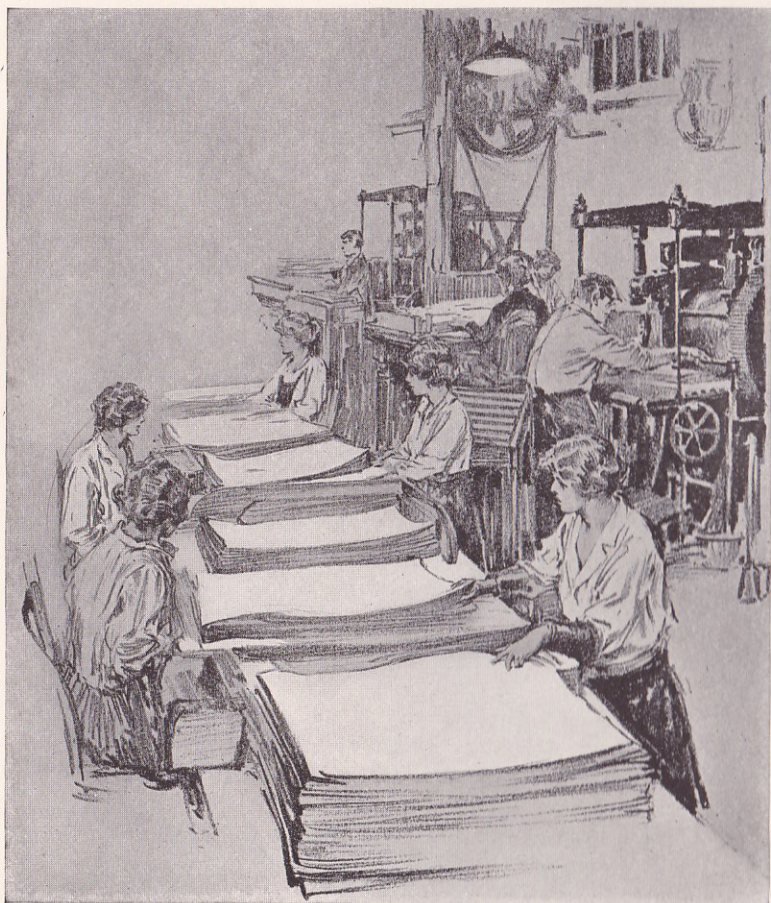
which hurries them up to the ceiling, there to toss them down a steep incline of iron slats. Through the slats such stray buttons as have passed the sorters are supposed to fall. A vigilant watch is kept for buttons, hooks and eyes, rubber, and other foreign material to the last moment, and there are many little devices for detaining them.

Finally, the rags are pushed down through a convenient opening in the floor and fall into an immense horizontal boiler of iron which holds about four tons. A chemical mixture is put in with the rags, the boiler is sealed up, and the steam is turned on. The boiler slowly revolves for many hours with the rags boiling inside.

When the boiler is opened the rags are pulled out into low-wheeled cars and are trundled by the workmen from the boiler room to the room adjoining, where they are thrown into great oval vats known as "washers." A stream of perfectly pure filtered water is turned on to wash the rags. Each vat is equipped with a heavy revolving iron wheel slatted with knives which convert the rags into their original fibers and brush these fibers into a uniform length and condition. The work of the knives continues for a number of hours, until the contents of the vat are reduced to a clean pulpy mass. Then a solution of chloride of lime is added for a bleach, and afterward the pulp goes to drainers where it stands until required for use. It comes from the drainers of a delicious whiteness, and looks good enough to eat. A paper-pulp pudding, if it tasted as good as it looks, would be a dish for an epicure.

The pulp is ground for another period in beating engines to further improve the fibers. Rosin size is added, and, several hours later, when it has been thoroughly mixed with the pulp, alum is put in. This causes the rosin to adhere to the fibers, closes the pores and makes the finished paper ink-resistant. Later color is added. The

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Plating

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natural tint of vegetable fibers has a slight yellow cast, and, even if the paper is to be white, a certain amount of dye has to be added to the pulp.

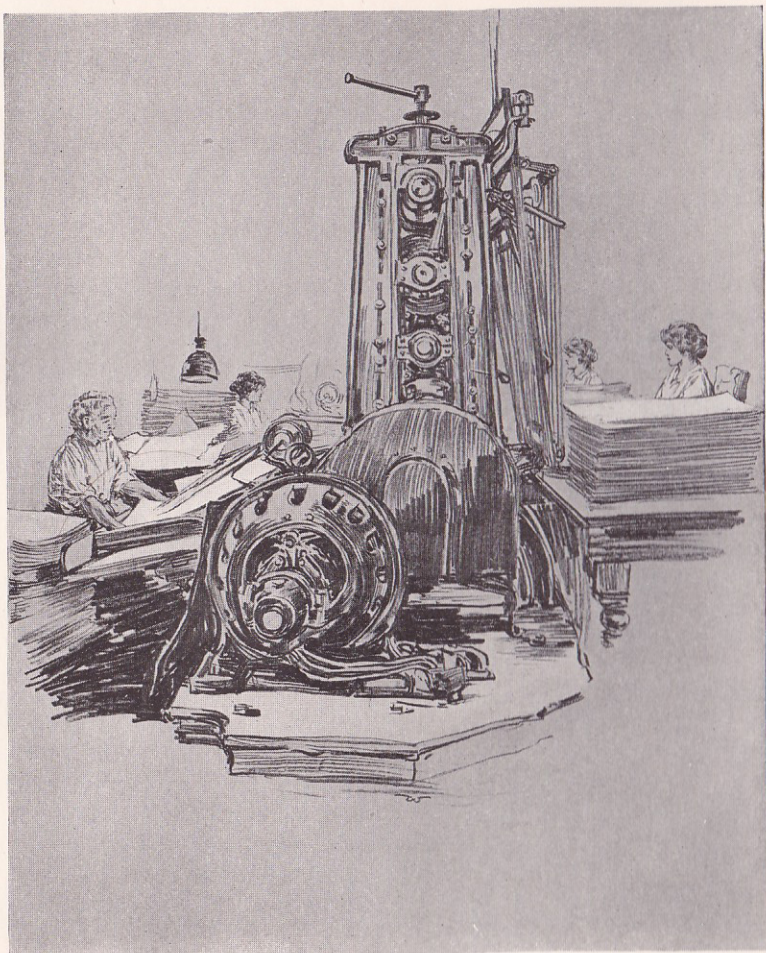
Now the pulp goes to the room where the paper "machines" are. The room is very large, the floors are wet, and steamy vapors rise from the machines. The atmosphere here is warm and moist, whatever the outside weather. The pulp flows through pipes from the engines to the "chest"—a big high-sided vat with long arms revolving inside to keep the contents stirring.

From this the pulp is pumped up to the machines, which are big and complicated and require most careful adjustment to produce the delicate sheet formation. They are about one hundred feet long and six feet wide. They have a wet end and a dry end. The pulp enters by way of the wet end, where it passes through a screen and flows out on to an endless wire straining cloth. It resembles thin milk, and, indeed, to all appearances is so nearly milk that you doubt the possibility of ever getting such material into solid sheets of paper. All this end of the machine is in quick, lateral motion to distribute the paper fiber evenly.

The wire cloth on which the thin stream of pulp travels along is of a mesh fine enough to permit the water to drain off without losing any of the pulp. After being carried several yards by the easy forward motion of the wire the substance has become a solid broad sheet of paper. It seems a miraculous transformation.

While the sheet is yet in a moist state on the wire cloth it passes beneath a revolving wire-covered cylinder called the dandy roll, which bears on its surface raised letters, and perhaps certain designs. These stamp what is known as the watermark in the paper. You can see it if you hold up a sheet and look through toward the light, but it is not usually apparent otherwise.

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A Calendar

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After a little more progress through press rolls and over a large number of cylinder dryers the paper becomes dry and firm. It then passes through a tank of gelatine, and the gelatine saturates the paper in a way that makes possible a perfected writing surface. Lastly the paper is delivered at the end of the machine from a revolving cutter in fast-falling sheets of the size desired.

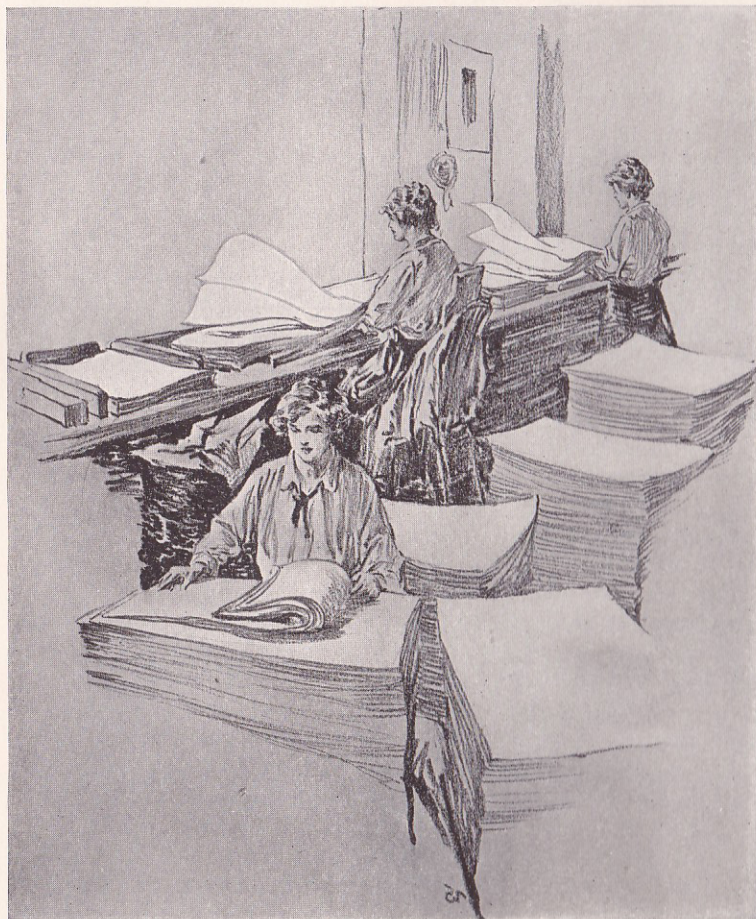
The paper then goes to the loft to dry. The sheets are hung over poles in folds of about fifteen in a "spur" or bunch, until a room is filled from floor to ceiling. Then heat is turned on, and there the paper stays for at least twenty-four hours. The product does not look very attractive as it comes from the loft. It is so wrinkled and rough that you begin to think it is a failure after all; but when it has been allowed to season, the calender girls take it and run it between the rolls of their machines, and it comes out beautifully fair and smooth.

An interesting process called "plating" is the giving to certain papers special finishes such as linen or crash. This is done by pressing the sheets of paper, usually 21 x 33 in size, between pieces of linen or crash cloth and zinc plates, alternating in regular order. First a zinc plate is laid down, on that is put a piece of cloth, then comes a sheet of paper, then a piece of cloth, then a zinc plate—and so on. When a sufficient pile has been made it is placed in a press of two steel rolls and run between them with sixty tons pressure. Thus the surface of the paper is embossed with the designs of the linen or crash textures.

All the paper has to be sorted. The sorters, as they sit at their tables, keep the sheets swiftly turning, and put the perfect sheets in one pile, the slightly imperfect in another, and the more defective in a third.

Then "counters" take the sheets, run them over rapidly, and lay them off in reams to be trimmed and wrapped for the market. The last work is that of the

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Sorting

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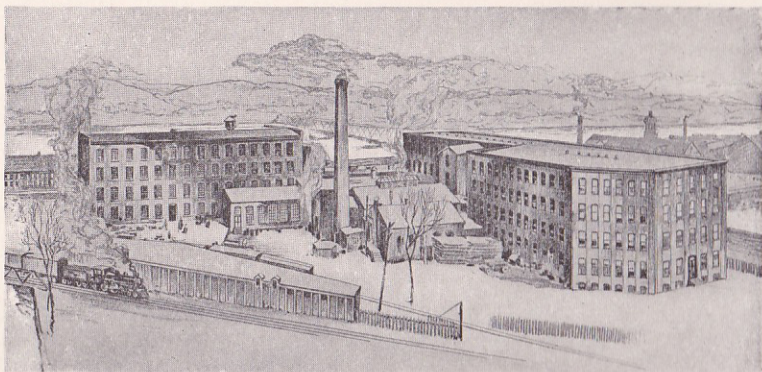
sealers, who deftly fold wrapping paper about the reams and secure it in place with gummed paper tape. They accumulate the neatly wrapped packages about them with astonishing rapidity.

If the paper is to be put into boxes with envelopes to match for retailing through the stationers, the large sheets are cut into small ones, which are folded, pressed, and banded. Envelopes are made on a very ingenious machine, which takes the queerly outlined sheets cut for it, and folds and gums them, and deposits the finished envelopes in a rack. A girl counts and bands them, and other girls take them away and put them and the paper in the boxes of varied design that are ready to receive them. Now they are ready to be packed in cases to be shipped to stationers the world over.

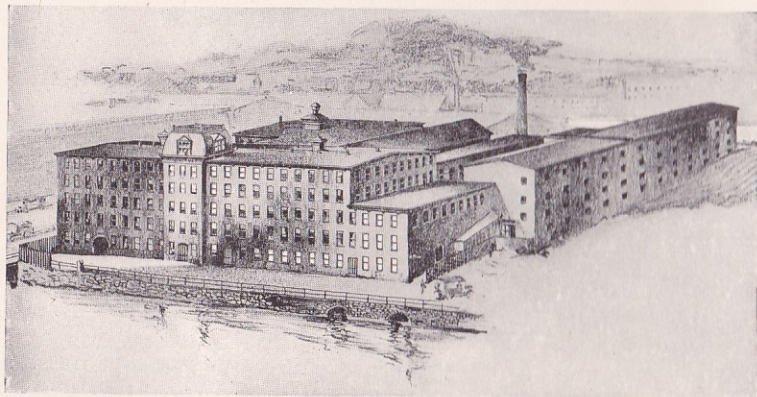
The facts noted in this little book and the pictures showing the processes of paper-making were obtained in one of the mills of the Whiting Paper Company at Holyoke, Massachusetts. The Whiting Paper Company are the largest manufacturers exclusively of loft dried papers in the world. They make a specialty of the fine wedding and correspondence papers handled by the stationers; and they also manufacture ledger papers, bond papers, linens, superfines—in fact, all varieties of first-class writing papers which are called for by the general paper trade—and whatever they make is preëminently good of its kind.

Great care is used in sizing the Whiting papers—that is, in giving them just the proper coating of a delicate gelatine solution. This renders the surface non-absorbent of ink, and gives it superior writing qualities and durability, and enables erasures to be made, when necessary, without disturbing seriously the fibrous body of the paper. These papers retain their firmness and color to a degree impossible with papers that are handled less scientifically and by other processes.

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Whiting Mill Number One



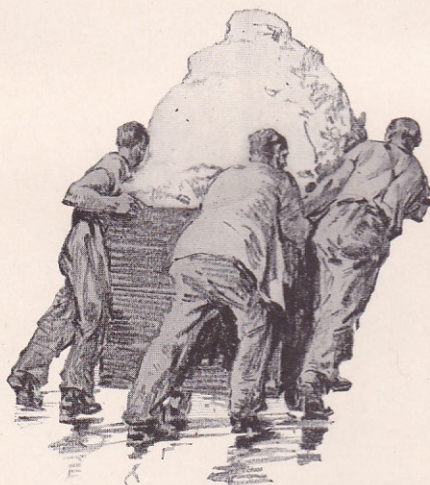
Whiting Mill Number Two

*These two great mills of the Whiting Paper Company are at Holyoke,
Massachusetts, beside the Connecticut River*

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The Whiting papers are loft dried—which means that they are suspended on poles in lofts and allowed to dry atmospherically. This is a natural process, permitting a free expansion and contraction that is not destructive of the fiber formation, and it produces a uniform and permanent sheet of the finest texture and quality.

No effort is spared to make the papers in every way such as people with taste and refinement will take a lasting satisfaction to use in either their private correspondence or for business purposes.



Some of the most notable of the Whiting papers for correspondence are Organdie, Woven Linen, Angora, Wedding Papers, Polo Cloth, Moorish Linen, Superfine, Crushed Antique, Oak Grain, Aletta Linen, French Cheviot, Lois Antique, Moleskin, and Chesterfield Linen.

WHITING PAPER COMPANY



NEW YORK · PHILADELPHIA · CHICAGO · BOSTON
Mills at HOLYOKE MASS.

Gathering
the Papyrus